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On the taxonomic position of the genera *Krundia*, *Breukoscelis*, and *Uphodato* (Hemiptera, Auchenorrhyncha, Fulgoroidea) described from the Insect Limestone of the Isle of Wight

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Three fossil genera, *Krundia* Szwedo, 2019, *Breukoscelis* Szwedo, 2019, and *Uphodato* Szwedo, 2019, described in the family Issidae are transferred to other families according to the shape and venation of forewings. *Krundia* Szwedo is transferred to the family Tropiduchidae. *Breukoscelis* Szwedo is placed in synonymy under *Uphodato* Szwedo and transferred to the family Cixiidae. Forewing venation of the members of Issidae, Tropiduchidae, and Cixiidae are discussed and illustrated.

Key words: systematics, morphology, new synonym, new combinations, Eocene, Tropiduchidae, Cixiidae, Bucini, Eucarpiini

In a recently published comprehensive study on Hemipteran insects from the Late Eocene of Isle of Wight (Szwedo *et al*. 2019) three new genera with four new species were described by J. Szwedo in the family Issidae Spinola, 1839. However, our study of imprint photos (Szwedo *et al*. 2019, Pl. 8, figs 5–8) and drawings (Szwedo *et al*. 2019, figs 45–48) provided for these new taxa suggests that they are better placed in different families. *Krundia korba* Szwedo, 2019 belongs to the family Tropiduchidae Stål, and may be tentatively placed in the tribe Bucini Gnezdilov, Bartlett et Bourgoin, 2016 currently comprised of the genus *Buca* Walker with three extant species from South America (Gnezdilov *et al*., 2016). *Breukoscelis vadimgratshevi* Szwedo, 2019, *B. phrikkosus* Szwedo, 2019, and *Uphodato garwoterus* Szwedo, 2019 belong to the family Cixiidae Spinola, 1839 and may be placed in the tribe Eucarpiini Emeljanov, 2002. Moreover, *Breukoscelis* Szwedo, 2019 and *Uphodato* Szwedo, 2019 are synonyms.

Material and methods

Morphological terminology generally follows Anufriev & Emeljanov (1988) and Gnezdilov & Bartlett (2018) for forewing venation.

Taxonomy

Family Cixiidae Spinola, 1839

Subfamily Cixiinae Spinola, 1839

Tribe Eucarpiini Emeljanov, 2002

Genus *Uphodato* Szwedo, 2019

Note. We suggest placement of *Breukoscelis* Szwedo, 2019 in synonymy under *Uphodato* Szwedo, 2019 as indicated by the basally concaved costal margin of forewing and peculiar venation of the wing discussed below.

A basal concavity in the costal margin of the forewing is a characteristic feature of the tribe Eucarpiini Emeljanov of Cixiidae and some Achilidae (the genera *Tropiphlepsia* Muir, 1924, *Apateson* Fowler, 1900, and *Achilixius* Muir, 1923), with their wings held steeply tectiform in repose. This concavity serves for optimal position of the hind legs before jumping. Issidae have no such concavity, as their legs are covered by forewings before jumping and are angled differently at

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jumping (Anufriev & Emeljanov, 1988, fig. 11: 7). The forewing in Issidae has the bulla in basal half under R_1 close to first furcation of the radius. Most issid species have convex forewings except, for example, *Oronoqua* Fennah, 1947 and *Eupilis* Walker, 1857 with flat wings; however, these genera have forewings with convex costal margins, without a concavity. The forewing imprint of *Uphodato garwoterus* Szwedo, 2019 exhibits a distinct "cixiid clavus", with $Pcu + A_1$ joining the wing margin before the claval apex, and with tubercles on setal bases on the veins (Fig. 1) which are characteristic features of Cixiidae, but not known for Achilidae.

Uphodato Szwedo, 2019 and *Breukoscelis* Szwedo, 2019 are distinguished by the stem *R* + *M* on the forewing (Figs 1, 2). Such a condition is known for extant *Dilacreon orpheus* (Fennah, 1956) (Fig. 4), described from Caroline Islands (Fennah, 1956), within the Eucarpiini. *Uphodato* and *Breukoscelis* are also characterized by a unique vein which may be treated as a transverse *m-cua* crossvein based on its position on the wing (Figs 1–3), but very likely it is the "root" of *CuA*, becoming a medio-cubital vein as a result of "interception" of the *CuA* by the *M*. In favor of this interpretation is the wing venation in members of the genus *Dilacreon* Fennah, 1980 illustrated by Fennah (1956, 1980), in particular, *D. orpheus*, which has a short stem *R* + *M*. However, on the drawings for *Uphodato* and *Breukoscelis* (Szwedo *et al*., 2019, figs 46–48) *CuA* is not furcating, which is not typical for Cixiidae. If our interpretation of vein "interception" is true, then *CuA* acquires the usual character of furcating. Thus, the species of the genus *Dilacreon* have the basal part of CuA_1 and prenodal vein *m-cua* situated symmetrically as though ready for "interception". The extravenal pterostigma is not visible on the imprints of fossil taxa; however, within extant Eucarpiini it is small or completely obsolete.

Uphodato Szwedo, 2019

Uphodato Szwedo, 2019: 367 (in Szwedo *et al*. 2019). Type species: *Uphodato garwoterus* Szwedo, 2019.
Breukoscelis Szwedo, 2019: 365 (in Szwedo *et al*. 2019), **syn. n.** Type species: *Breukoscelis vadimgratshevi* Szwedo, 2019.

Uphodato garwoterus Szwedo, 2019

Uphodato garwoterus Szwedo, 2019: 367, pl. 8: 8, fig. 48 (in Szwedo *et al*. 2019).

Uphodato vadimgratshevi (Szwedo, 2019), comb. n.

Breukoscelis vadimgratshevi Szwedo, 2019: 365, pl. 8: 6, fig. 46 (in Szwedo *et al*. 2019).

Uphodato phrikkosus (Szwedo, 2019), comb. n.

Breukoscelis phrikkosus Szwedo, 2019: 367, pl. 8: 7, fig. 47 (in Szwedo *et al*. 2019).

Family Tropiduchidae Stål, 1866
Subfamily Elicinae Melichar, 1915
Tribe Bucini Gnezdilov, Bartlett et Bourgoin, 2016
Genus *Krundia* Szwedo, 2019

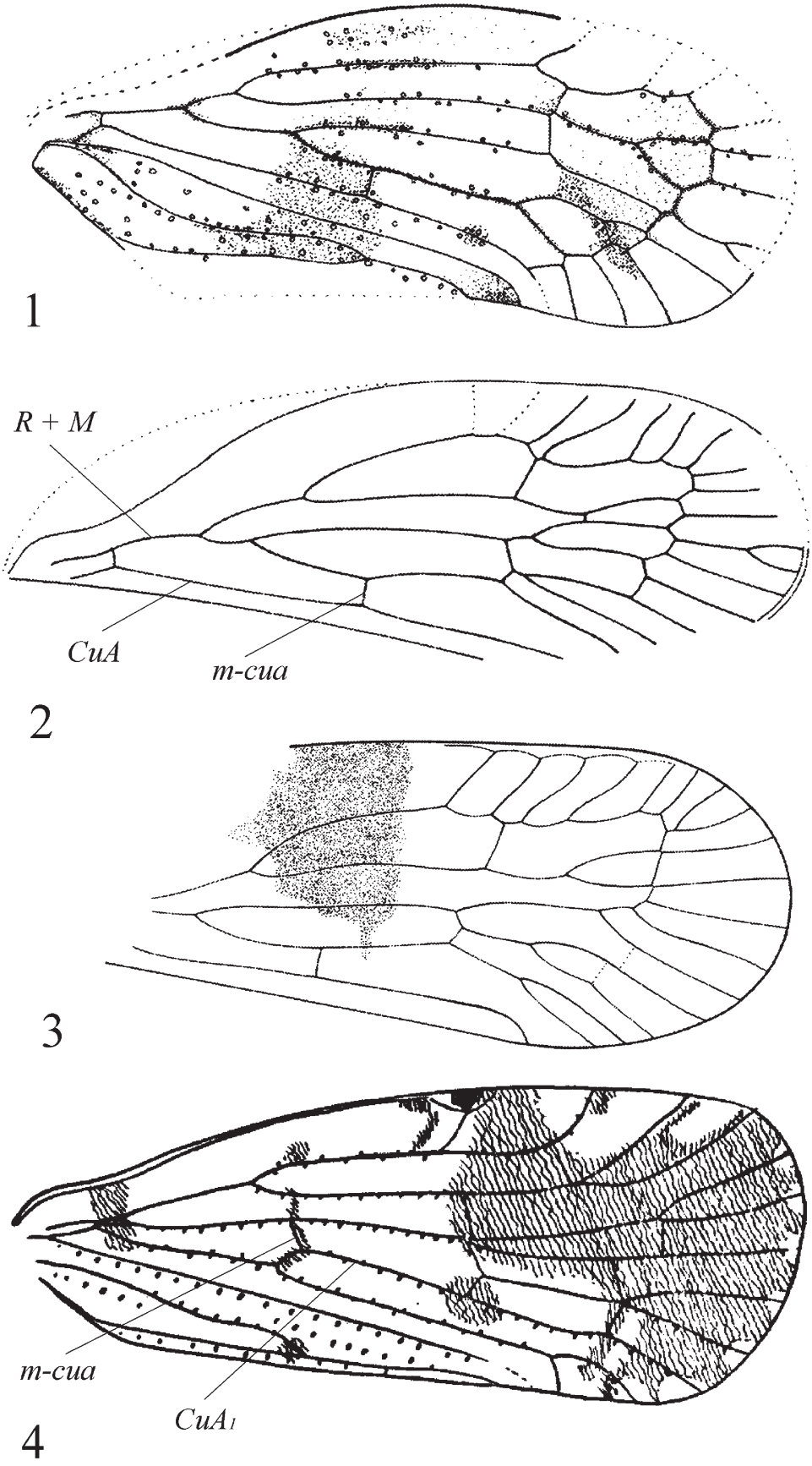
Krundia Szwedo, 2019: 365 (in Szwedo *et al*. 2019). Type species: *Krundia korba* Szwedo, 2019.

Krundia korba Szwedo, 2019

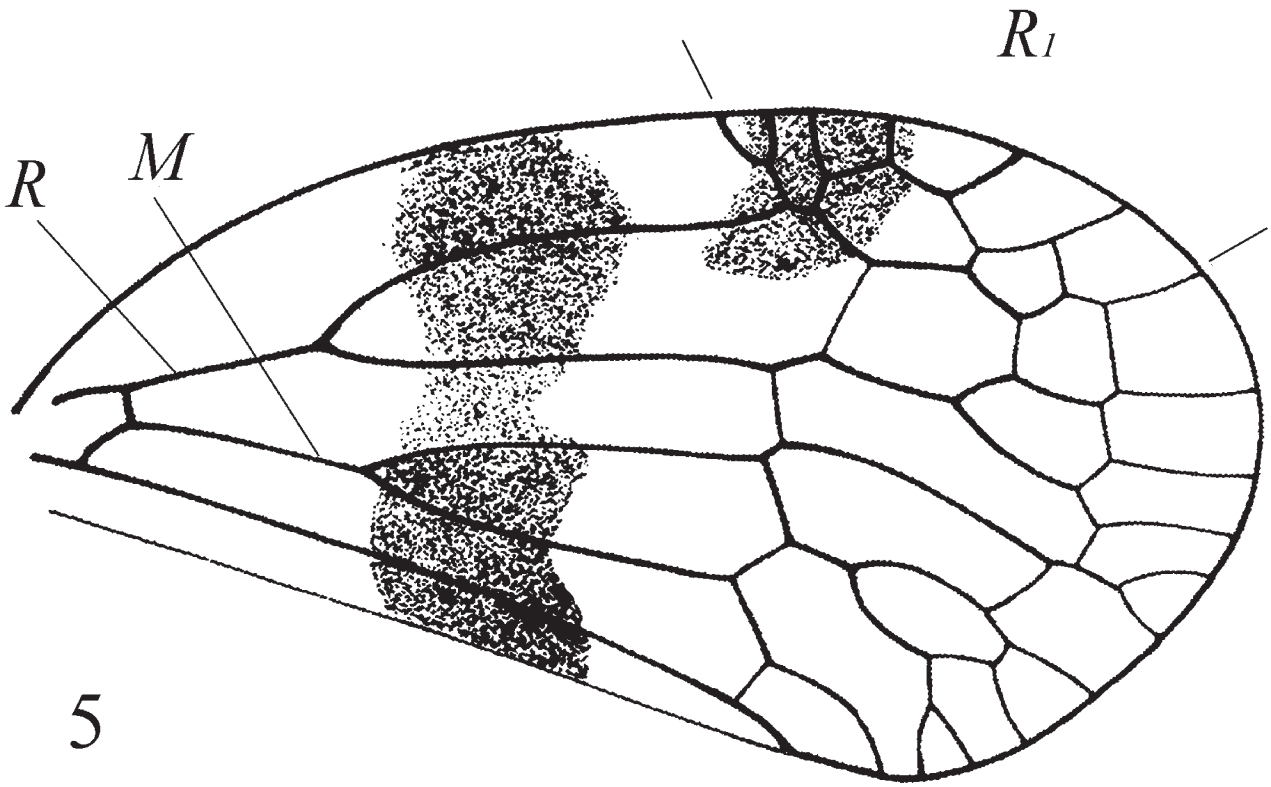
Krundia korba Szwedo, 2019: 365, pl. 8: 5, fig. 45 (in Szwedo *et al*. 2019).

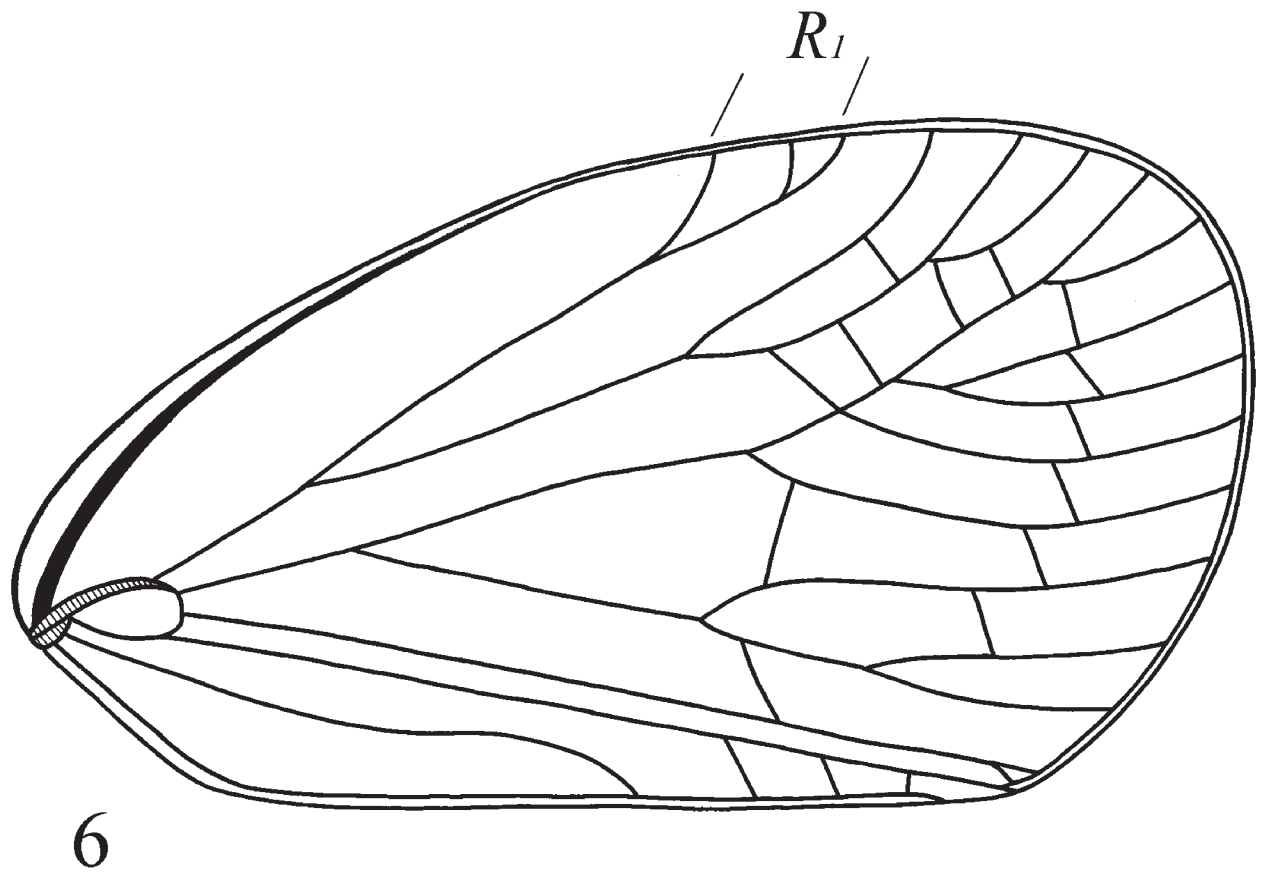
Note on forewing veneation. Forewing enlarged apically. First furcation of *R* and *M* at the same level in basal third of the wing. *R* and *M* multibranched in the distal part of the wing. *CuA* single. Transverse veins *ir*, *r-m*, *im*, and *m-cua* form appearance of nodal line (Fig. 5). According to these features *K. korba* is close to species of the genus *Buca* Walker, 1858, in particular, the venation is similar with R_1 furcating apically known for *Buca truncoptera* Gnezdilov, Bartlett et Bourgoin, 2016 (Fig. 6).

The apically enlarged forewing is not a typical feature for Issidae. In Issidae *R* furcates before *M*, main veins poorly furcate apically or not furcate, nodal line never present (Figs 7, 8).

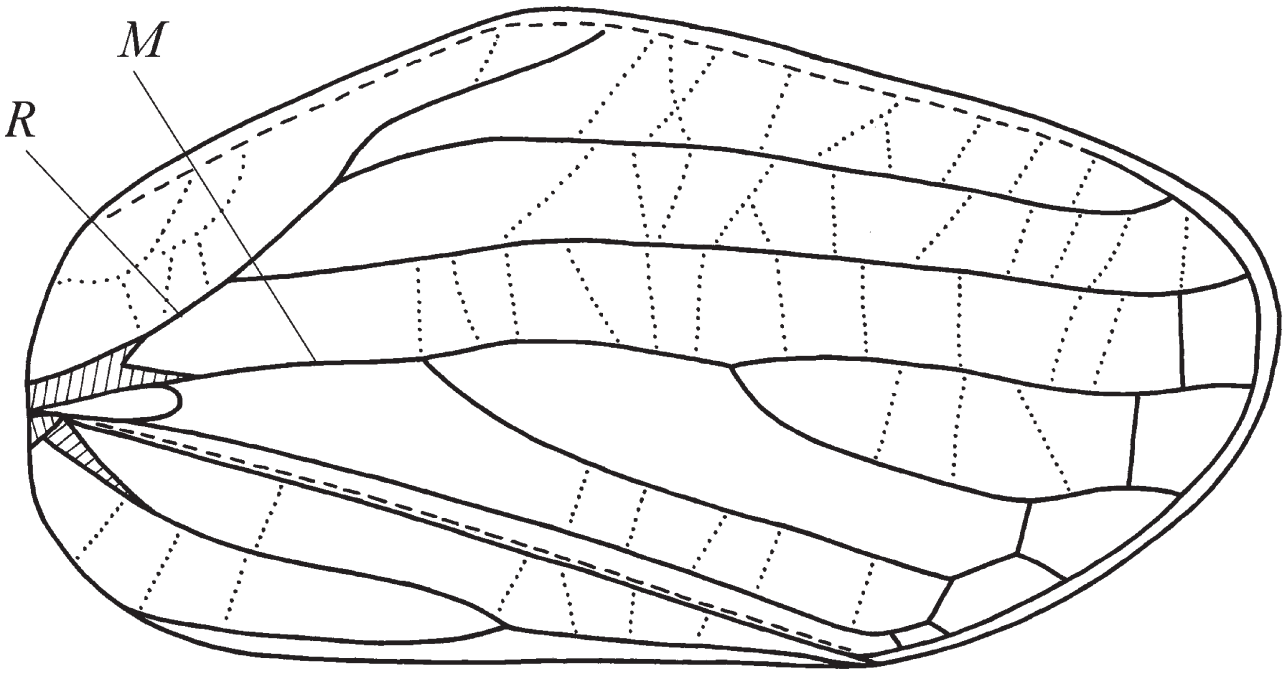


FIGURES 1–4. Eucarpiini, forewing. 1. *Uphodato garwoterus* Szwedo; 2. *U. vadimgratshevi* (Szwedo); 3. *U. phrikkosus* (Szwedo); 4. *Dilacreon orpheus* (Fennah). 1–3 after Szwedo *et al*. (2019), modified, 4 after Fennah (1956).





FIGURES 5–6. Bucini, forewing. 5. *Krundia korba* Szwedo (after Szwedo *et al*. (2019), modified); 6. *Buca truncoptera* Gnezdilov, Bartlett et Bourgoin (after Gnezdilov *et al*. (2018), modified).



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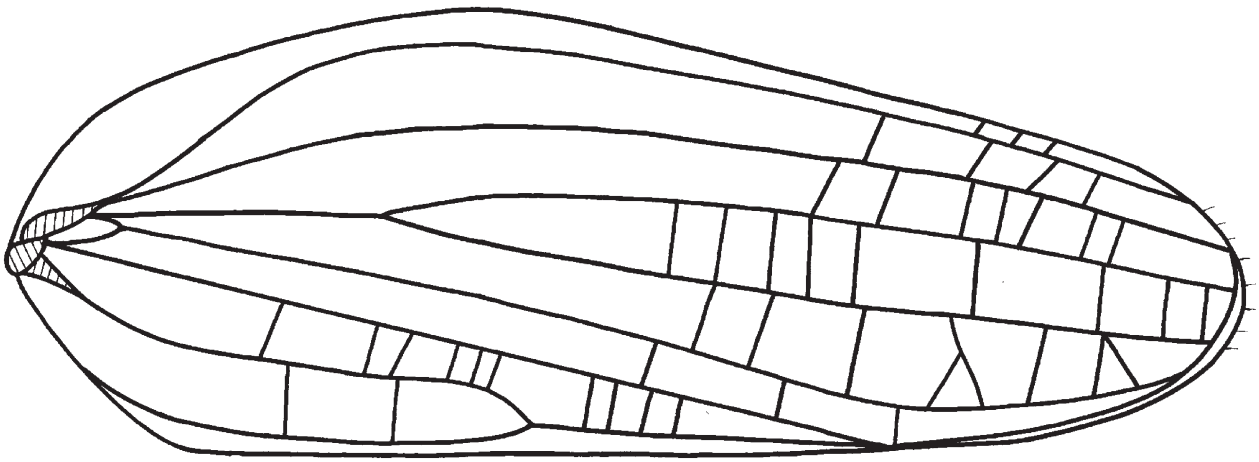

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FIGURES 7–8. Issidae, forewing. 7. *Kovacsiana abyssinica* Synave (after Gnezdilov, 2017, modified); 8. *Waorania jaguarina* Gnezdilov et Bartlett (after Gnezdilov & Bartlett, 2018).

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